National Aeronautics and Space Administration

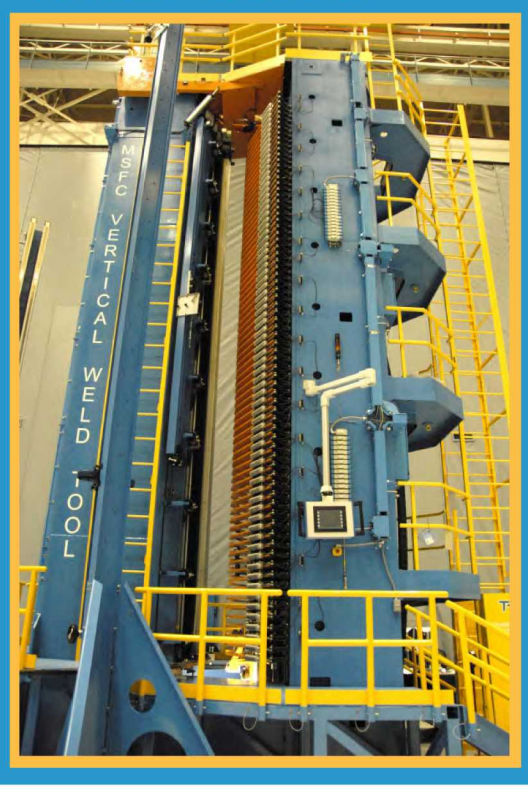
advanced welding concepts

Solid State Welding

NASA continues to explore innovative ways to join materials and assemble hardware components. Different mechanisms are being used to generate heat sufficient to plasticize—but not melt—a wide range of parent materials, in order to create solid-state welds of high quality.

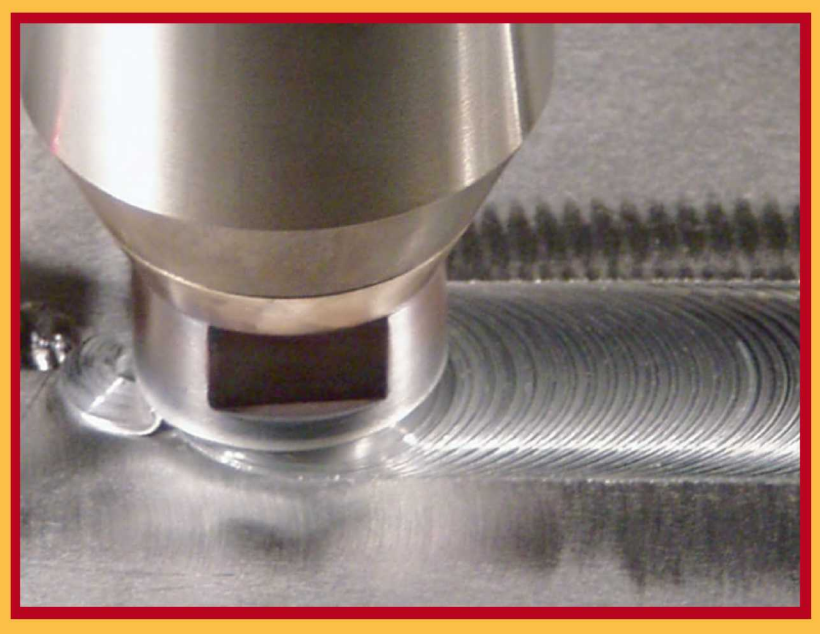
These processes offer:

- *Adaptability* to nearly all materials, including dissimilar alloy combinations
- *No fluxes or fillers* and, in most cases, no shielding gases
- *Short cycle times* controlled by computer
- *Simplified weld parameters* (position/force control, rpm, and travel rate for pin tools and stir rods)



Friction Stir Welding (FSW)

creates heat through friction under pressure.

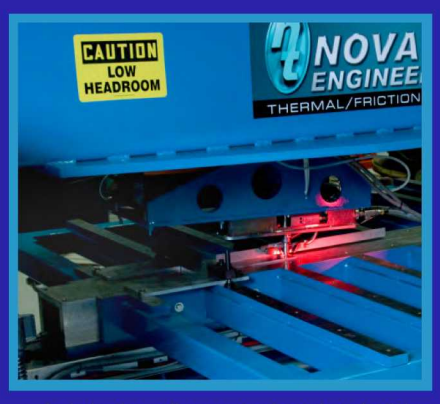


- *Conventional FSW* pushes a pin tool against a robust anvil, generating frictional heat by applying axial force.

- *Self-reacting FSW (SR-FSW)* uses a pin tool with external shoulders that are squeezed together using NASA-patented technology, generating frictional heat by exerting pinch force.

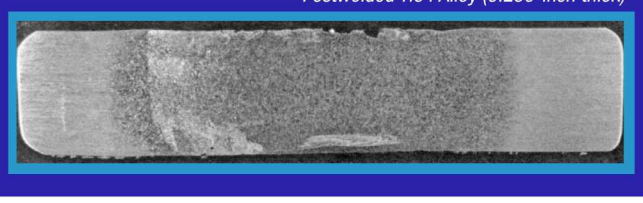
Thermal Stir Welding (TSW)

produces heat through electromagnetic induction.



- An induction coil generates heat that plasticizes the faying edges of a work piece. Then a stir rod stirs them together to create a weld joint.
- This process decouples heating, stirring, and forcing, allowing each to be independently controlled.

Postwelded Ti64 Alloy (0.250-inch thick)



Ultrasonic Stir Welding (USW)

generates heat by creating sound waves from ultrasonic energy.

- An ultrasonic transducer generates heat that plasticizes the faying edges of a work piece. Then a stir rod stirs them together to create a weld joint.
- This unique process has been patented by NASA.

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